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INSTRUCTION MANUAL
FOR
MODEL 69
PHASE JITTER
MEASURING SET

NORTHEAST ELECTRONICS CORPORATION

P.O. BOX 649 – CONCORD, N.H. 03301

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ISSUE 1

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SECTION 1

DESCRIPTION

1.1 GENERAL DESCRIPTION. The Model 69 is a self contained phase jitter measuring set and can be used in conjuntion with the Models 58B or the TTS 58A for phase hits measurements.

1.2 The Model 69 will measure the peak to peak phase jitter, in degrees of a 1000 Hz signal. The phase jitter is read on a self-contained meter with a 1^{o} to 100^{o} log scale.

1.3 Input line connections are made to the tip-ring-sleeve binding posts or a jack for a 310 type plug. A DIAL jack and switchable hold coil are provided for dialing through. Line bridging or 750Ω termination is provided. The input is balanced and DC blocked for 100V. A set of binding posts and a jack for a 310 type plug are provided for connecting the Model 69 output circuit to the 58 Series line input for impulse phase hit measurement. A conversion chart from dBrn to degrees for phase hits is supplied.

Figure 3-1 Front Panel Controls

SECTION 3

OPERATING INSTRUCTIONS

3.1 FRONT PANEL CONTROLS (Refer to Fig. 3-1).

Name of Control	Function
1. FUNCTION	Switches the TIP-RING input line terminals to the DIAL jack or to the set input balance transformer.
2. BRDG -TERM	Provides for bridging or terminaing a circuit.
3. HOLD-NO HOLD	Provides for connecting a hold coil across the TIP-RING terminals of the incoming line .
4. MEAS. NOISE-MEAS. PHASE	Switches the TIP-RING input line terminals to the input circuit of the phase jitter set or to the OUTPUT TIP-RING terminals when in the MEAS-NOISE position .
5. ADJUST FOR MINIMUM/READ (SWITCH)	Selects a faster time constant for locking on frequency when in the ADJUST FOR MIN. position.
6. ADJUST FOR MINIMUM (CONTROL)	Provides the means for frequency locking the phase jitter set to the test signal frequency
7. POWER - ON - OFF	Power Switch
8.	Jacks are provided for 310 plugs for the LINE, DIAL and OUTPUT circuits In addition binding posts are provided for the LINE and OUTPUT circuits
9.	Jack designated TTS 58A power can be used to supply power to the TTS 58A IMPULSE COUNTER for AC operation.

3.2 OPERATION

a. Model 69 Remove cover, connect AC power cord to commercial power outlet.

IMPORTANT

Internal 115/230 V ac selector switch is set to 115 V ac at factory. For 230 V ac operation, set must be removed from case and slide switch activated to desired position.

b. Turn power swith Model 69: If used with TTS 58A Impulse Counter, patch between 310 jack designated TTS 58A power located on Model 69 front panel to TTS 58A 310 POWER jack designated -48V POWER. Negative voltage appears on the tip and sleeve is ground in all cases. This feature provides for operating the TTS 58A off commercial power if desired.

c. Apply power to the TTS 58A. Model 58B or Model 58BR. (See Model 58B, Model 58BR or TTS 58A operating instructions.)

3.3 Connect the external line to be tested to the 310 LINE jack or to the TIP-RING-SLEEVE binding post of the phase measuring set.

3.4 If the connection is to be dialed:

a. Connect a dial or telephone set to the 310 jack designated DIAL.

b. Place FUNCTION switch to DIAL position. (This transfers the LINE terminals to the DIAL jack).

c. Activate toggle switches for desired functions i.e. TERM, HOLD MEAS. PHASE.

d. Dial the desired number.

e. When line connection has been established, place FUNCTION switch to TEST (1000Hz) position.

NOTE

Test frequency dialed must be 1000Hz $\pm$10%.

f. The dial may now be removed. The internal hold circuit will maintain the connection.

3.5 TO MEASURE PHASE JITTER

a. With the switch in the READ position, slowly rotate the control R30, (located near the meter) over it's entire range until frequency lock is indicated and then carefully adjust for minimum reading. Read phase jitter in peak to peak degrees directly on meter.

NOTE

Frequency lock is indicated when meter reads on scale.

If unable to adjust for frequency lock, follow steps (b) and (c).

b. With READ switch in the ADJUST FOR MINIMUM position, slowly adjust control for minimum meter reading.

c. Place switch in the READ position and readjust for minimum reading. Read phase jitter in peak to peak degrees directly on meter.

3.6 TO MEASURE PHASE SHIFT DUE TO IMPULSE.

a. Patch cord between phase measuring set TIP-RING binding posts or jack for 310 plug designated OUTPUT and the LINE input of the IMPULSE COUNTER (58B, 58BR, TTS 58A, etc.)

b. TTS 58A: Set front panel controls as follows:

1. INPUT switch set to 600 Ω
2. Place BRDG-TERM switch to BRDG position.
3. WTG switch set to EXT position
4. Connect strap between IN and OUT binding posts
5. Set channels A, B, and C sensitivity controls and main sensitivity control to cover desired span of degrees to be measured. (See Table 3-1)

c. Set Model 58B front panel controls as follows:

1. Turnbutton switch to MEAS. position.
2. Depress pushbuttons for 600Ω BRDG and BAL XFMR.
3. NETWORK switch set to EXT. position.
4. Set BLANKING INTERVAL for desired count rate, between 4 pps to 100 pps.
5. Set SELECTOR switch to Channel A.
6. Set MIN. LEVEL control (IMPULSE NOISE) and INCREMENT control to sensitivity corresponding to desired span of degrees to be measured. (See Table 3-2)

3.7 Adjust for minimum reading as outlined in paragraph 3.5 a. and b. above.

NOTE:
Peak to peak phase jitter reading on meter must be below the span of interest when making phase hits measurements.

TABLE 3-1

Main Sens. Control	Channel	Sens. Controls	Channel Sens.	Corresponding Phase Hits
70	C	10	80 dBrn	16^{o}_{o}
70	B	6	76 dBrn	10^{o}_{o}
70	A	0	70 dBrn	5^{o}

TABLE 3-2

Min. Level (Impulse Noise dBrn)	Increment Thresh. Level	Channel Sens.	Corresponding Phase Hits
70	12	D-82 dBrn	20^{o}
70	8	C-78 dBrn	12.5^{o}
70	4	B-74 dBrn	8^{o}
70	0	A-70 dBrn	5^{o}

3.8

a. Set IMPULSE COUNTER TIMER to desired time in minutes.

b. On the Model 58B, immediately and momentarily depress the COUNT/RESET key switch to RESET position. For the TTS 58A, reset all three mechanical counters. This resets all counters to 0 and establishes the start of the test.

3.9

a. At the end of test, when timer has returned to 0, record individual readings accumulated on mechanical counters on TTS 58A. For example: (See Table 3-3) Readings indicate that 122 phase hits due to impulse noise exceeded 5° phase shift but were less than 10°. 50 phase hits exceeded 10° but were less than 16° 2 phase hits were greater than 16°

b. In the case of the Model 58B, set SELECTOR switch to each channel and record individual readings For example: (See Table 3-4). Readings indicate a total of 112 hits due to impulse noise and resulted in phase shifts equal to or greater than 5°; 82 of these were equal to or greater than 8°; 25 were equal to or greater than 12.5° and 6 were equal to or greater than 20°.

c. To by-pass phase measuring set to measure IMPULSE NOISE or CIRCUIT NOISE with 58B or TTS 58A, place MEAS NOISE/MEAS PHASE toggle switch in MEAS NOISE position. This connects the external line directly to the IMPULSE COUNTER LINE input.

TABLE 3-3

Main Sens. Control	Channel	Sens. Controls	Cha. Sens.	Readings (Phase Hits)	Corres. Phase Hits
70	C	10	80 dBrn	2	16°
70	B	6	76 dBrn	50	10°
70	A	0	70 dBrn	122	5°

TABLE 3-4

Min. Level Impulse Noise	Increment Thresh, Level	Channel Sens.	Readings (Phase Hits)	Corres. Phase Hits
70	12	D-82 dBrn	6	20°
70	8	C-78 dBrn	25	12.5°
70	4	B-74 dBrn	82	8°
70	0	A-70 dBrn	112	5°

SECTION 4

CIRCUIT DESCRIPTION

4.1 The 1kHz signal connected to the input is ac coupled by transformer T-1. The secondary is connected to a low-pass filter and the input signal subsequently applied to the AMP-LIMITER (U1, Q1 and Q2).

4.2 The waveform at the output of the AMP-LIMITER is a rectangular pulse and is applied to a divide by two, ($\frac{1}{2}$ U2). The complimentary outputs of the divide by two are connected to two separate phase shift detectors.

4.3 A local oscillator with a frequency twice that of the incoming input signal is connected to a divide by two, ($\frac{1}{2}$U2) with it's complimentary outputs, in turn, applied to two other divide by two intergrated circuits (U3).

4.4 One half of U3 provides a signal in quadrature with the input signal to the phase detector enclosed in the lock loop. The output signal is averaged, filtered, amplified and the resulting signal used to control the local voltage controlled oscillator. The response of the lock loop is essentially speeded up when switch S-7 is in the ADJ. FOR MINIMUM position. This fast response facilitates locking the local oscillator to the input signal frequency.

4.5 With switch S-7 in the READ position, the lock loop response is slow enough to allow measurement of phase jitter with low modulation frequencies. Typically as low as 10 Hz.

4.6 The other half of U3 is connected to the other phase detector . The width of the rectangular pulse appearing at the output of this phase detector varies with the phase shift of the incoming signal. This pulse is applied to a circuit which converts the pulse width variations to peak amplitude variations (Q10 and Q11). Waveshape appearing at the output of the pulse width to amplitude modulation converter is sawtooth in nature and is applied to a buffer circuit Q13 providing an output signal for phase hits detection.

4.7 This same sawtooth is also applied to a peak detector ($\frac{1}{2}$U6), with the resulting output dc. component applied to the D. C. Log converter, ($\frac{1}{2}$U6, Q6 and Q7). The dc output of the log converter is applied to a dc amplifier (U7), driving the meter.

4.8 The transistors Q8, Q9, Q16, and Q17 constitute a phase correction detector circuit providing for the correct polarity at the output of the PHASE DETECTOR CIRCUIT ($\frac{1}{2}$U4).

SECTION 5

MAINTENANCE AND CALIBRATION

5.1 MAINTENANCE. The schematics block diagram and printed circuit board diagrams identify circuit components. Waveforms and voltages appear on the schematic diagrams. Components are identified by letter symbols according to the following convention:

C	capacitor
CR	diode
E	printed circuit board
J	jack or connector
L	inductor
Q	transistor
R	resistor
S	switch
T	transformer
U	intergrated circuit

5.2 MALFUNCTIONS. In the event of a malfunction ensure that:

a). The power cord is properly connected to available power.

b). All external line plugs are properly wired and inserted in the correct jacks.

c). All switchs and controls are set in accordance with the OPERATION section of this manual.

d). The test being performed is within the specifications limit of the instrument.

5.3 When it has been determined that a malfunction does exist, proceed as follows:

a). Switch off power to the set and remove power cord.

b). Remove (4) captive screws and carefully withdraw entire set from cover.

c). Re-connect power cord and

d). Use the following table on page 5-2

5.4 CALIBRATION; If calibration is found to be necessary, it is recommended that customer return the set to the factory for recalibration.

NOTE

Replacement of the intergrated circuits U6 or U8 would require factory recalibration.

TROUBLESHOOTING TABLE

SYMPTOM	PROBABLE CAUSE
1). Meter remains at mechanical zero setting when power is applied. (Pilot Lamp is on).	Power Supply failure. Check power supply voltages for +5VDC and +12 VDC. Check CR-5. Check T-2, CR-106, U101, and U102, check Q101 and Q102.
2). Pilot Lamp does not light when power is applied.	Power Supply failure. Check fuse F-1, power switch, S-3 and 115/230 VAC selector switch S-6.
3). Unable to get meter to read on scale. (Indicates $> 100^{o}$)	Loss of test signal or local osc. failure. Use oscilloscope to observe waveforms at indicated points outlined in Fig. 5-1 in order to localize problem area. Logic waveforms indicated are for properly operating set.
4). Unable to get meter to read on scale. Indicates $\ll 1^{o}$ with no input signal.	Check transistor circuits associated with U8 and U9. Follow same procedure as outlined in 3 above.
5). No signal at output of PHASE HITS terminals.	Check Q13 and associated circuitry.

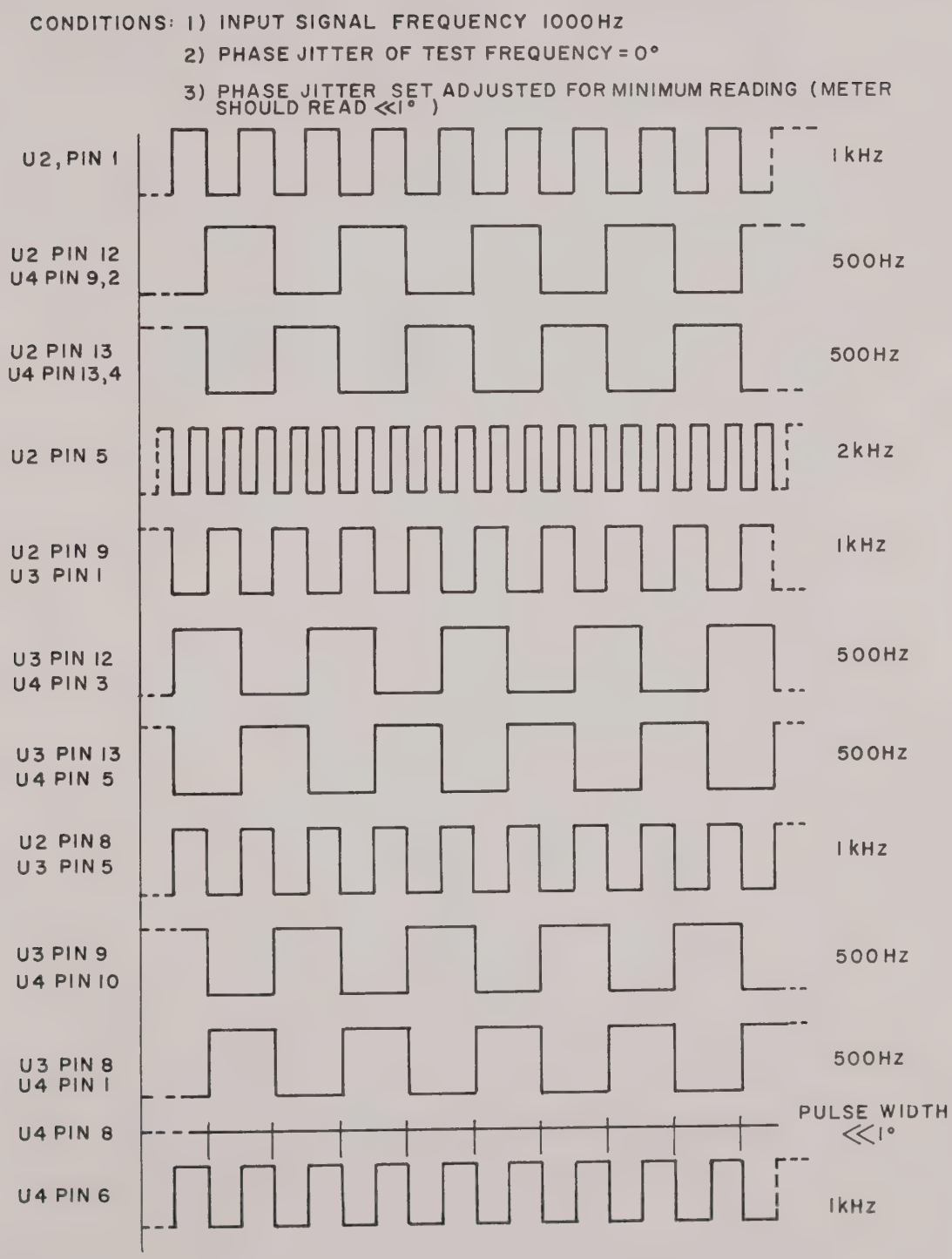


Fig. 5-3 Relative Logic Waveforms At Indicated Points

SECTION 6

ELECTRONIC PARTS LIST

6.1 INTRODUCTION. The following pages contain the parts list for the Model 69

6.2 FSCM Code Numbers. This is the Federal Supply Code of Manufacturers as issued October 1969. A list of codes and their respective manufacturers is given on page 6-2.

LIST OF MANUFACTURERS

Code No.	Manufacturer
01121	Allen-Bradley, Milwaukee, Wis. 53204
01295	Texas Instruments Inc. Semiconductor Div., Dallas, Tex. 75231
02567	International Electronic Industries, Nashville, Tenn. 37204
05397	Union Carbide, "Kemet", N.Y., N. Y. 10017
06486	IRC Division of TRW, Lynn, Mass. 01905
06555	Beede Electrical Instrument Co. Penacook, N.H. 03301
12065	Transitron Electric Corp., Boston, Mass. 02128
12954	Dickson Electronics Corp., Scottsdale, Ariz. 85252
13606	Sprague Electric Cp., Concord, N. H. 03301
15873	Motorola Inc., Arcade, N. J. 14009
17117	Electronic Moulding Corp., Pawtucket, RI. 02860
17538	Precision Electronics, Mansfield, Mass. 02050
17803	Fairchild, Semiconductor Div., Mountain View, Calif. 94041
22650	Whale Electronics, Nashville, Tenn. 37204
44655	Ohmite Mfg. Co., Skokie, Ill. 60076
49671	RCA Corp., N.Y., N. Y. 10020
71450	CTS Corp., Elkhart, Ind. 46514
71590	Centralab, Milwaukee, Wis. 53201
71744	Chicago Miniture Lamp, Chicago, Ill. 60640
72765	Drake Manfacturing, Hawood Heights, Ill. 60656
75915	Littelfuse Inc., Des Planes, Ill. 60016
80223	United Transformer Co., N.Y., N. Y. 10013
80368	Sylvania Electric Inc., N.Y., N. Y. 10017
82389	Switchcraft Inc., Chicago, Ill. 60630
84432	Newton Engineering, Newton, Mass. 02161
94322	Tel&Labs Inc., Manchester, N.H. 03102

PD&E Assoc., Waltham, Mass., (No FSCM code number listed)

MAIN ASSEMBLY

Ref. Desig.	Description	Manufacturer (FSCM Code#)	Part Number
T1	Transformer, input	80223	A-20 or GR-815
T2	Transformer, power	17538	NEC-2
L1	Hold coil	86632	TN1274
S1	S:	71590	PA-1002
S2	S:	09353	7101
S3, S4	S:	09353	7201
S5	S:	09353	7401
S6	S:	82389	46206LF
S7	S:	09353	7101
J1, J2	Jack	82389	L12B
J3, J4	Binding post	17117	5595-175-2
J5	Binding post	17117	5595-175-0
J6	Jack	82389	L12B
J7	Binding post	17117	5595-175-2
J8	Binding post	17117	5595-175-0
J9	Jack	82389	L12B
J10	AC receptacle	82389	AC3G
F1	Fuse 1/10A Slo-Blow	75915	MDL 1/10
DS-1	Pilot light (neon)	72765	HR118T-603
M-1	Meter	06555	Model 204
R1, R2	R: 383Ω $\frac{1}{2}$W 1%	06486	CECTO
R30	Pot. 250K 30%	71450	5VA-45
C28	C: 300μF 3V	02567	APD081
C1	C: 2.2μF 100V	22650	51-6838
LP-1	Neon Lamp	71744	NE-2

Printed Circuit Board E-14-038 53-008

Ref Desig.	Description	Manufacturer (FSCM Code#)	Part Number
R101	R: 100Ω 3W	13606	242E1015
R102	R: 1500Ω ¼W ±10%	01121	CB
R103	R: 470Ω ¼W ±10%	01121	CB
R104	R: 4.53K 1/8W ±1%	06486	CEATO
R105	R: 2200Ω ¼W ±10%	01121	CB
R106	Pot. . 2K	71450	UPE200RE1
R107	R: 5.49K 1/8W +1%	06486	CEATO
R108	R: 250Ω 2watt	13606	240E251J
R109	R: 2000Ω 1/8W ±1%	06486	CEATO
R110	Pot: 2K	71450	UPE200RE1
R111	R: 9.09 K1/8W ±1%	06486	CEATO
R112	R: 1500Ω ¼W ±10%	01121	CB
R113	R: 470Ω ¼W ±10%	01121	CB
R114, R115	R: 2.49K 1/8W ±1%	06486	CEATO
C101, C102	C: 250μF 50V	13606	39D257G050HE4
C103	C: 0.005μF 50V	71590	CK-502
C104	C: 200 pF 1KV	71590	DD-201
C105	C: 250μF 50V	13606	39D257G050HE4
C106	C: 0.005μF 50V	71590	CK-502
C107	C: 200pF 1KV	71590	DD-201
C108	C: 100μF 20V	02567	APD-095
CR101, CR102	Diode	12065	1N4148
CR103	Diode, zener, 6.2V ±5%	12954	1N823
CR104, CR105	Diode	12065	1N4148
CR106	Diode, package	PD&E	NSS3058A
Q101, Q102	Transistor NPN	49671	2N2102
U101, U102	Intergrated circuit	01295	SN72709

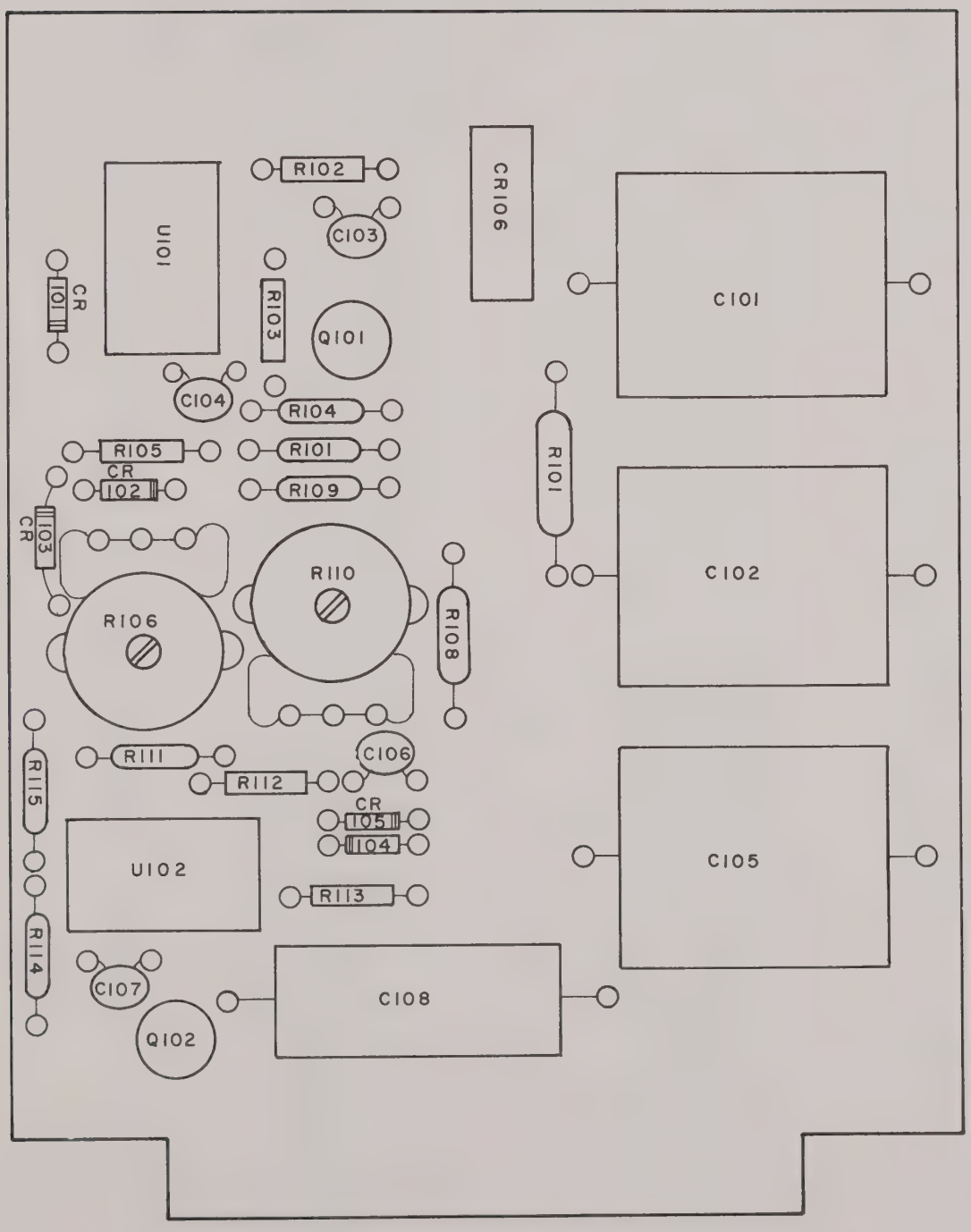


Figure 6-1 Component Location E-14-038-53-008

Printed Circuit Board E95634

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
R3	R: 10K $\frac{1}{4}$W 10%	01121	CB
R4,R5	R: 1M $\frac{1}{4}$W 10%	01121	CB
R6	R: 1.5K $\frac{1}{4}$W 10%	01121	CB
R7	R: 1.8K $\frac{1}{4}$W 10%	01121	CB
R8	R: 220Ω $\frac{1}{4}$W 10%	01121	CB
R9	R: 100K $\frac{1}{4}$W 10%	01121	CB
R10	R: 1K $\frac{1}{4}$W 10%	01121	CB
R11	R: 10K $\frac{1}{4}$W 10%	01121	CB
R12	R: 27Ω $\frac{1}{4}$W 10%	01121	CB
R13	R: 1K $\frac{1}{4}$W 10%	01121	CB
R14	R: 220Ω $\frac{1}{4}$W 10%	01121	CB
R15,R16	R: 110 K1% 1/8W	06486	CEATO
R17	R: 33Ω $\frac{1}{4}$W 10%	01121	CB
R18	R: 1K $\frac{1}{4}$W 10%	01121	CB
R19	Pot., 50K 10%	06486	500 Series
R20	R: 180Ω $\frac{1}{2}$W 1%	94322	CR-16
R21	Pot., 100Ω 10%	06486	500 Series
R22	R: 3.3 K $\frac{1}{4}$W 10%	01121	CB
R23	R: 1.5K $\frac{1}{4}$W 10%	01121	CB
R24	R: 1M $\frac{1}{4}$W 10%	01121	CB
R25	Pot., 50K 10%	06486	500 Series
R26	R: 4.7K $\frac{1}{4}$W 10%	01121	CB
R27	R: 10K $\frac{1}{4}$W 10%	01121	CB
R28,R29	R: 15K $\frac{1}{4}$W 10%	01121	CB
R31	R: 390K $\frac{1}{4}$W 10%	01121	CB
R32	R: 15K $\frac{1}{4}$W 10%	01121	CB
R33	R: 22K $\frac{1}{4}$W 10%	01121	CB
R34	R: 100K $\frac{1}{4}$W 10%	01121	CB
R35	R: 1.5K $\frac{1}{4}$W 10%	01121	CB
R36	R: 10K $\frac{1}{4}$W 10%	01121	CB
R37,R38	R: 5.6K $\frac{1}{4}$W 10%	01121	CB
R39	R: 560Ω $\frac{1}{4}$W 10%	01121	CB
R40	R: 2.2K$\frac{1}{4}$W 10%	01121	CB
R41,R42	R: 30.1K 1/8W 1%	06486	CEATO
R43	R: 2.2K $\frac{1}{4}$W 10%	01121	CB
R44,R45	R: 100K $\frac{1}{4}$W 10%	01121	CB
R46	R: 22K W10%	01121	CB
R47	R: 33K $\frac{1}{4}$W 10%	01121	CB
R48	R: 27Ω $\frac{1}{4}$W 10%	01121	CB
R49	R: 560Ω $\frac{1}{4}$W 10%	01121	CB
R50	R: 10Ω $\frac{1}{4}$W 10%	01121	CB
R51	R: 39K $\frac{1}{4}$W 10%	01121	CB
R52	R: 47K $\frac{1}{4}$W 10%	01121	CB
R53	R: 10K $\frac{1}{4}$W 10%	01121	CB
R54	R: 1.5K $\frac{1}{4}$W 10%	01121	CB
R55	R: 7.5K 1/8W 1%	06486	CEATO
R56	Pot. 2K 10%	06486	500 Series
R57	Pot., 5K 10%	06486	500 Series

Printed Circuit Board E95634 (cont)

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
R58,R59	R: 100K ¼W 10%	01121	CB
R60	R: 470Ω ¼W 10%	01121	CB
R61	R: 680Ω ¼W 10%	01121	CB
R62,R63,R64	R: 10K ¼W 10%	01121	CB
R65	Pot., 50K 10%	06486	Series 500
R66	R: 560K ¼W 10%	01121	CB
R67,R68,R69	R: 1K ¼W 10%	01121	CB
R70	R: 6.19K ±1% 1/8W	06486	CEATO
R71,R72,R73,R74	R: 22K ¼W 10%	01121	CB
R75	R: 100Ω ¼W 10%	01121	CB
R76	R: 10K ¼W 10%	01121	CB
C2	C: 0.47μF 25V	13606	5C11
C3,C4	C: 0.005μF 50V	71590	CK-502
C5	C: 200 pF 1KV	71590	DD-201
C6	C: 22μF6V	05397	K22W6K
C7	C: 220 pF 1KV	71590	DD-221
C8	C: 8.2μF 15V	05397	K8R2W15K
C9	C: 0.01μF 50V	71590	CK-103
C10	C: 0.005μF 50V	71590	CK-502
C11	C: 200 pF 1KV	71590	DD-201
C12	C: 1.0μF 25V	13606	5C13
C13	C: 0.005μF 50V	71590	CK-502
C14	C: 200 pF 1KV	71590	DD-201
C15 C15A	C: 1.0μF 25V	13606	5C13
C16 C16A	C: 22μF 6V	05397	K22W6K
C17,C18	C: 0.01μF 100V	13606	225P
C19,C20	C: 0.0056μF 100V	13606	225P
C21	C: 0.47μF 25V	13606	5C11
C22,C23	C: 100μF 15V	13606	TE-1162
C24	C: 0.47μF 25V	13606	5C11
C25	C: 15μF 10V	05397	K15W10K
C26	C: 0.0082 100VDC 10%	13606	225P
C27	C: 0.47μF 25V	13606	5C11
C29	C: 0.47μF 25V	13606	5C11
C30	C: 22μF 6V	05397	K22W6K
C31	C: 0.082μF 35V	05397	KR082W35K
C32	C: 8.2μF 15V	05397	K8R2W15K
C33	C: 10 pF 1KV	71590	DD-100
C34	C: 82 pF 1KV	71590	DD-820
U1	Intergrated circuit	01295	SN72709
U2,U3	Intergrated circuit	01295	SN7473N
U4	Intergrated circuit	01295	S7451N
U5	Intergrated circuit	01295	SN72709
U6	Intergrated circuit	17803	μA739C
U7	Intergrated circuit	01295	SN72709
U8	Intergrated circuit	49671	CA3046

Printed Circuit Board E95634 (cont)

Ref Desig.	Description	Manufacturer (FSCM Code#)	Part Number
U9	Intergrated circuit	49671	CA3046
Q1	Transistor	15873	2N3903
Q2	Transistor	15873	2N3905
Q3	Transistor	15873	MPS-6515
Q9	Transistor	01295	2N1375
Q11	Transistor	15873	2N3905
Q14, Q15	Transistors	49671	2N2102
CR1, CR2, CR3, CR4	Diode	12065	1N4148
CR5	Diode	80368	1N2069

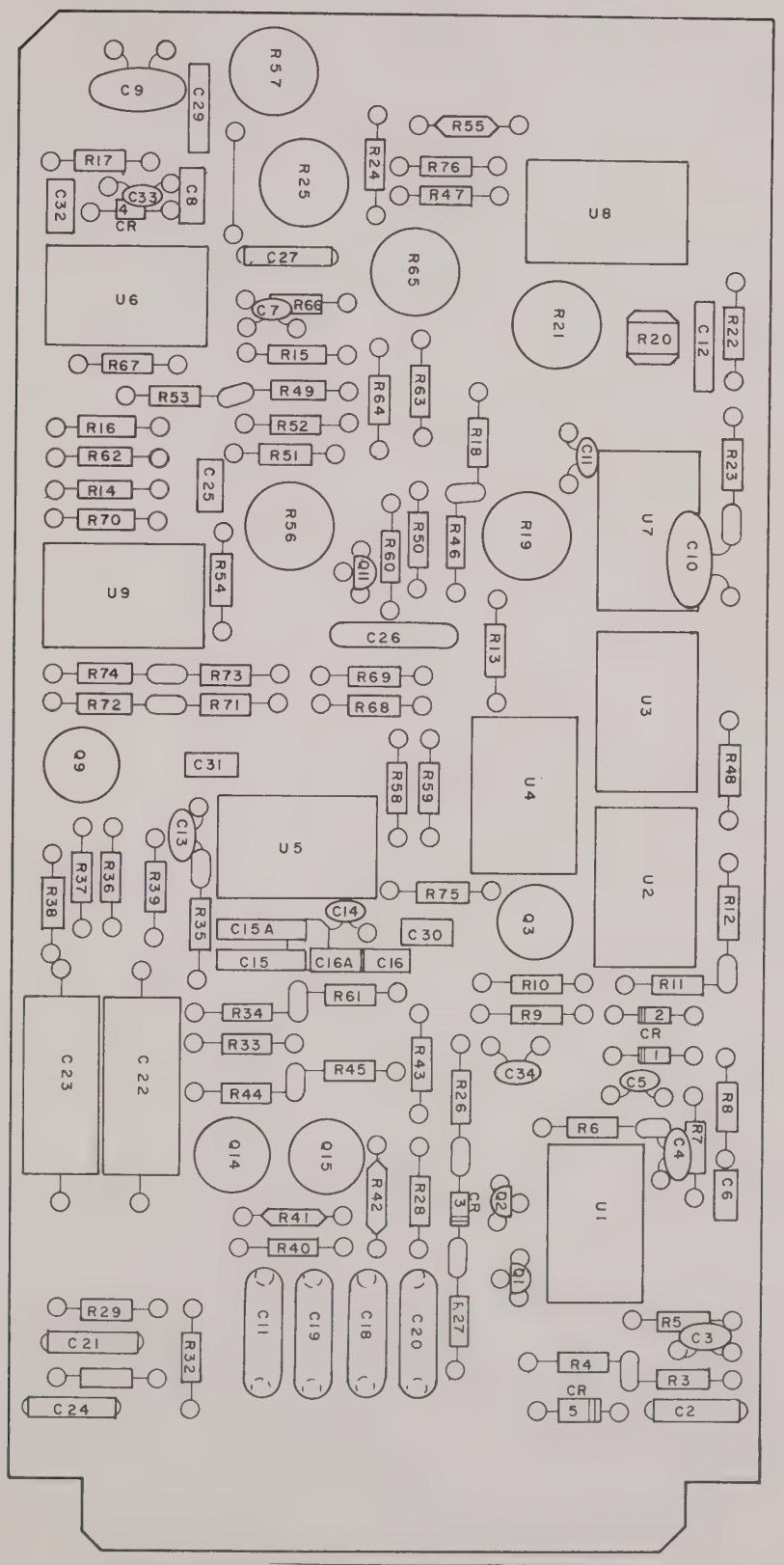


Figure 6-2 Component Location E95634

SECTION 7

SCEMATIC DIAGRAMS

7.1 INTRODUCTION. The following pages contain the schematic diagrams for the Model 69.

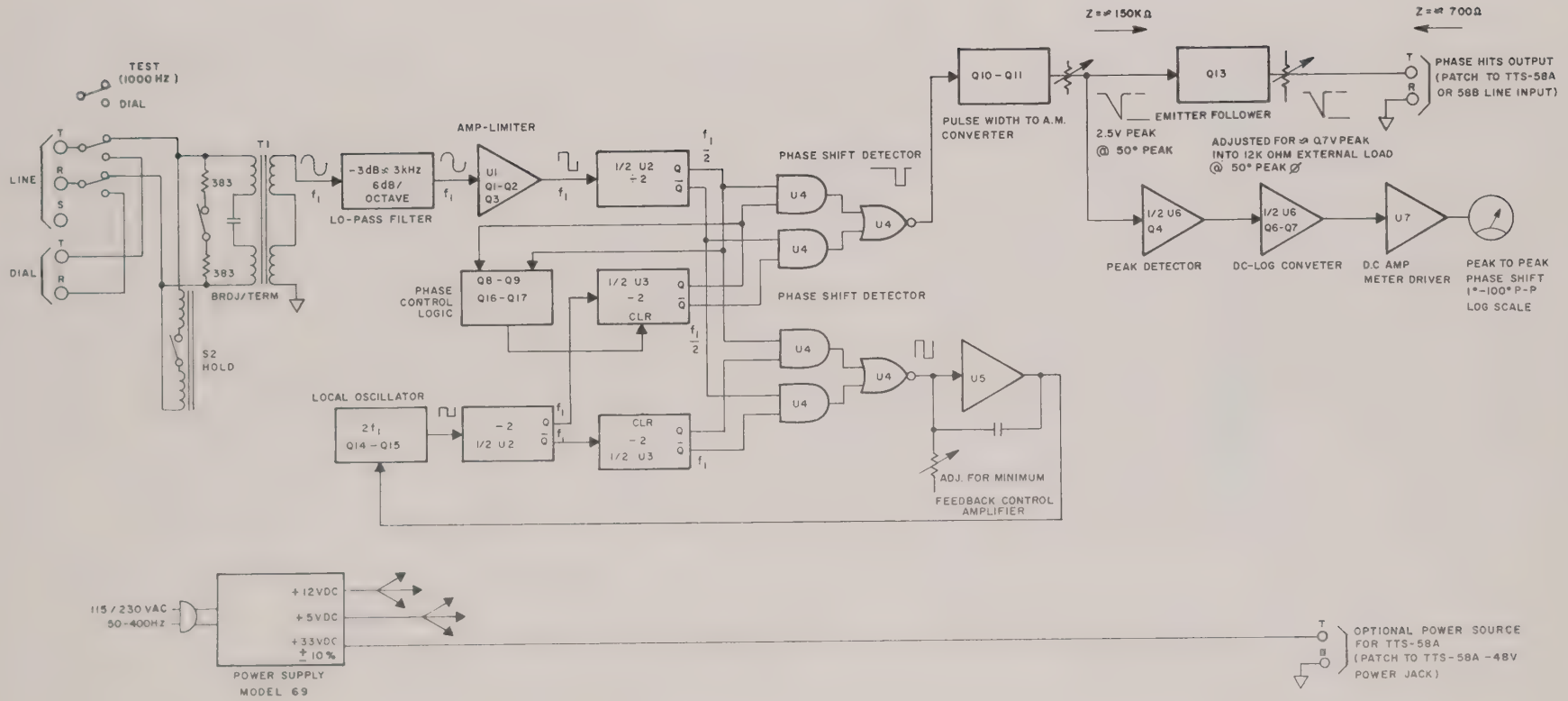
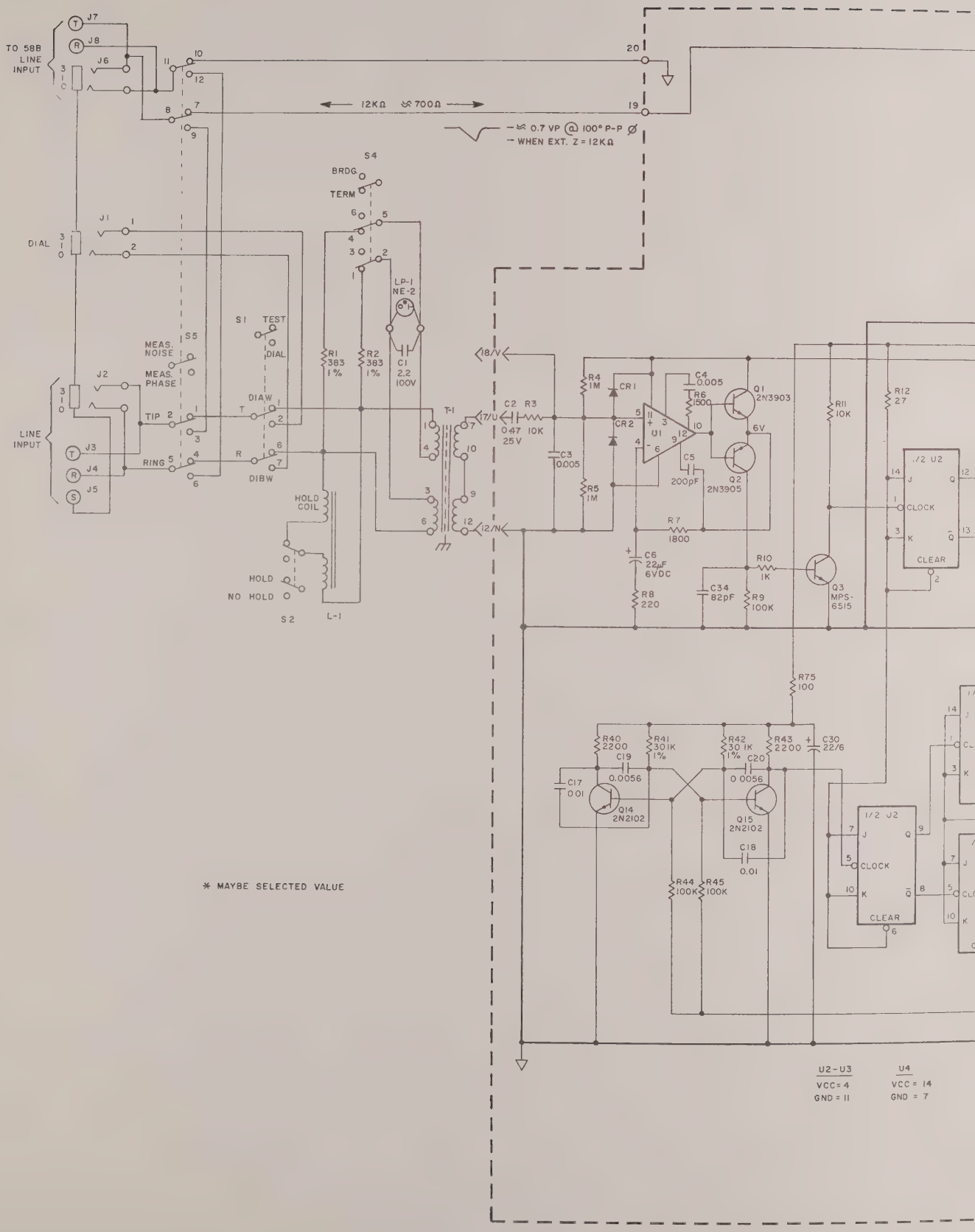


Figure 7-1 Model 69 Block Diagram.



* MAYBE SELECTED VALUE

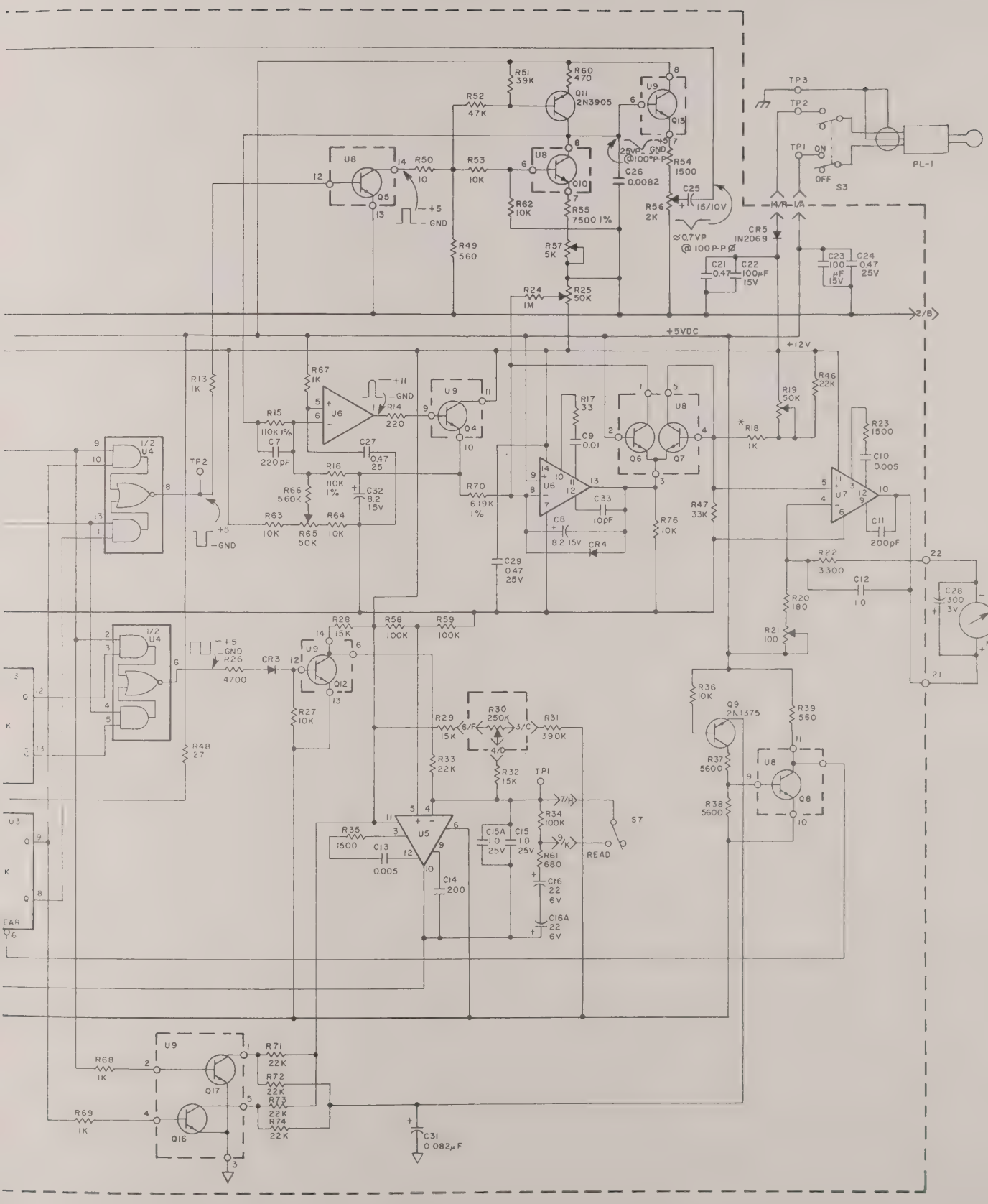


Figure 7-2 Model 69 Schematic Diagram.

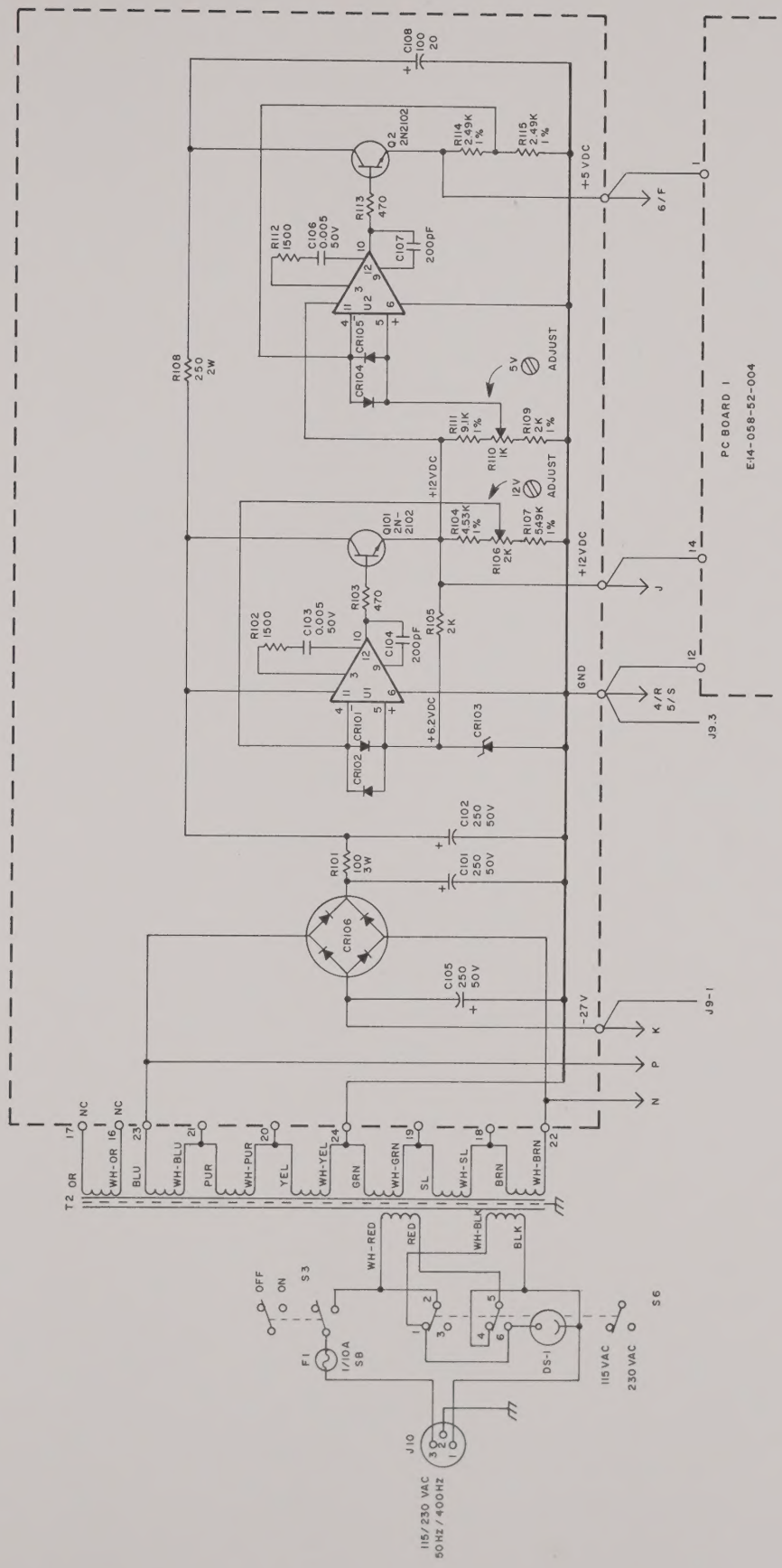


Figure 7-3 Model 69 Power Supply Schematic Diagram.